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A higher proportion of vegetation survived at the LKD site than is usual for this type of revegetation project. This image shows revegetation and the Munster Plant in the background.

Revegetating harsh environments: lime and cement kiln dust residue areas

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Revegetating some landscapes may be more challenging than others. Previous land use may dramatically affect soil composition and structure, which can influence survival and growth of vegetation planted at these sites. These landscapes may often require a tailored approach to revegetation, which takes these factors into account.

Lime and Cement Kiln dust (LKD/CKD) are by-products of the lime and cement making processes. These products are mixed with water to produce slurry and deposited into residue areas. Quarry 5 Upper is a LKD and CKD residue area situated north-east of the Cockburn Cement Ltd. Munster plant. This quarry was revegetated in 2009 to reduce dust, increase aesthetic amenity, increase biodiversity, and increase habitat for fauna (see Figure 1).

Methods & Results

Following decommission of the quarry, topsoil was added and the site was ripped to alleviate compaction caused by LKD deposition. Local native plant species (suited to a highly alkaline and calcareous substrate and local climatic conditions) were chosen for revegetation. The 43 plant species selected have a range of forms (e.g. canopy, midstorey and understorey species) and functions (e.g. nutrient cycling capacity and flowering at different times of the year).

Approximately 11,000 seedlings were planted in July 2009 (see Figure 2). Seedlings were purchased from a local native plant nursery (Men of the Trees, Rockingham Branch) to make sure that local provenance seed was used where possible, to ensure the production of quality planting stock, and to support local industry. A number of 5 x 5m monitoring quadrats were established and monitored in November 2009 and June 2010 to determine seedling survival over the first year from planting.

Figure 1 LKD revegetation site with Tegan Douglas.

Figure 2 Quarry 5 Upper, an example of a Lime Kiln Dust residue area, prior to revegetation.

Challenges to revegetating

pH and nutrient content: There are many challenges of revegetating these waste areas; in particular, due to the high pH and low organic carbon (Ruthrof et al. 1997). At high pH (alkaline pH), problems may arise for plant growth due to decreased availability of nutrients such as iron, zinc, nitrogen and phosphate. Organic carbon levels reflect the amount of organic matter in soils. Organic matter is valuable for plant growth as it increases soil porosity, water infiltration, water holding capacity and nutrient reserves.

Compaction: The hard surface of LKD/CKD residue areas can be a challenge to revegetation for a number of reasons, including making it difficult to physically plant seedlings, impeding root growth, and reducing water infiltration. Poor water infiltration can result in ponding of water to pond on the soil surface which can contribute to seedling death during winter rains. Deep ripping can help alleviate these issues by cracking the top layer of LKD/CKD. Subsequent addition of topsoil and overburden then provide more substrate and organic matter to improve plant growth.

Planting: A range of native plant seedlings are planted at a high density (3,000-4,000 seedlings/ha). A slow-release fertiliser tablet is placed with each plant to provide nutrients in the first few months, encouraging root and shoot growth before the seedlings face their first long dry summer period.

Lessons learned: This study has provided us with important information regarding revegetation of challenging landscapes, including development of site preparation techniques to assist with water infiltration and identification of local plant species that can establish and grow in these harsh conditions.

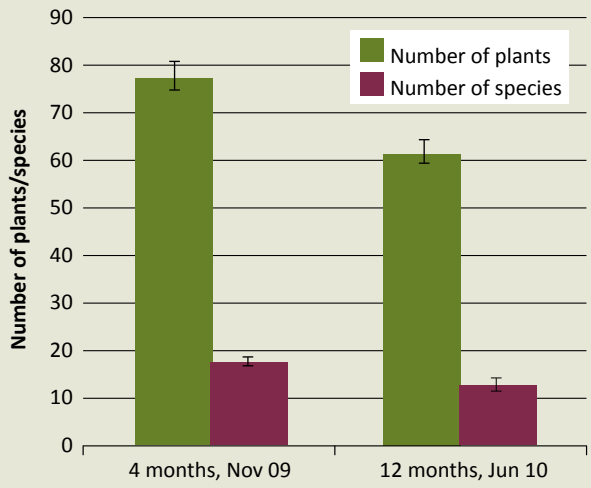

Figure 3 The mean number of plants and species in three representative quadrats in Quarry 5 Upper, monitored in November 2009 and June 2010.

Figure 4 A higher proportion of vegetation survived at the LKD site than is usual for this type of revegetation project. This image shows a flowering acacia being monitored by the author.

A high plant survival rate (number of plants as well as species) was recorded: approximately 80% of seedlings planted survived the first year since planting (see Figures 3 and 4). The high survival rate was unexpected given a number of factors, including: the low amount of topsoil on top of the LKD, the lateness of the planting (July, rather than June), the unusual frost events that occurred following planting, and the 2009/2010 summer being one of the longest and driest summer periods experienced in Perth for many years.

Conclusions & Recommendations

The high survival rate is a positive outcome, especially given that the first summer is often the most challenging for revegetation. Monitoring of seedling survival will be continued over a number of years to determine longer term survival success and to inform on-going annual revegetation activities at Cockburn Cement Ltd.

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Reference

1. Ruthrof, K. X. (1997) Improving the success of limestone quarry revegetation. *Cave and Karst Science*, v. 24, 117-125.